

Patterns of Injury in Association with Mild, Moderate and Severe Brain Trauma as a Function of Motor Vehicle Crash Direction and Restraint System

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Accident Cause and Analysis:

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Case Presentation

Sedan vs Van

Lateral Crash

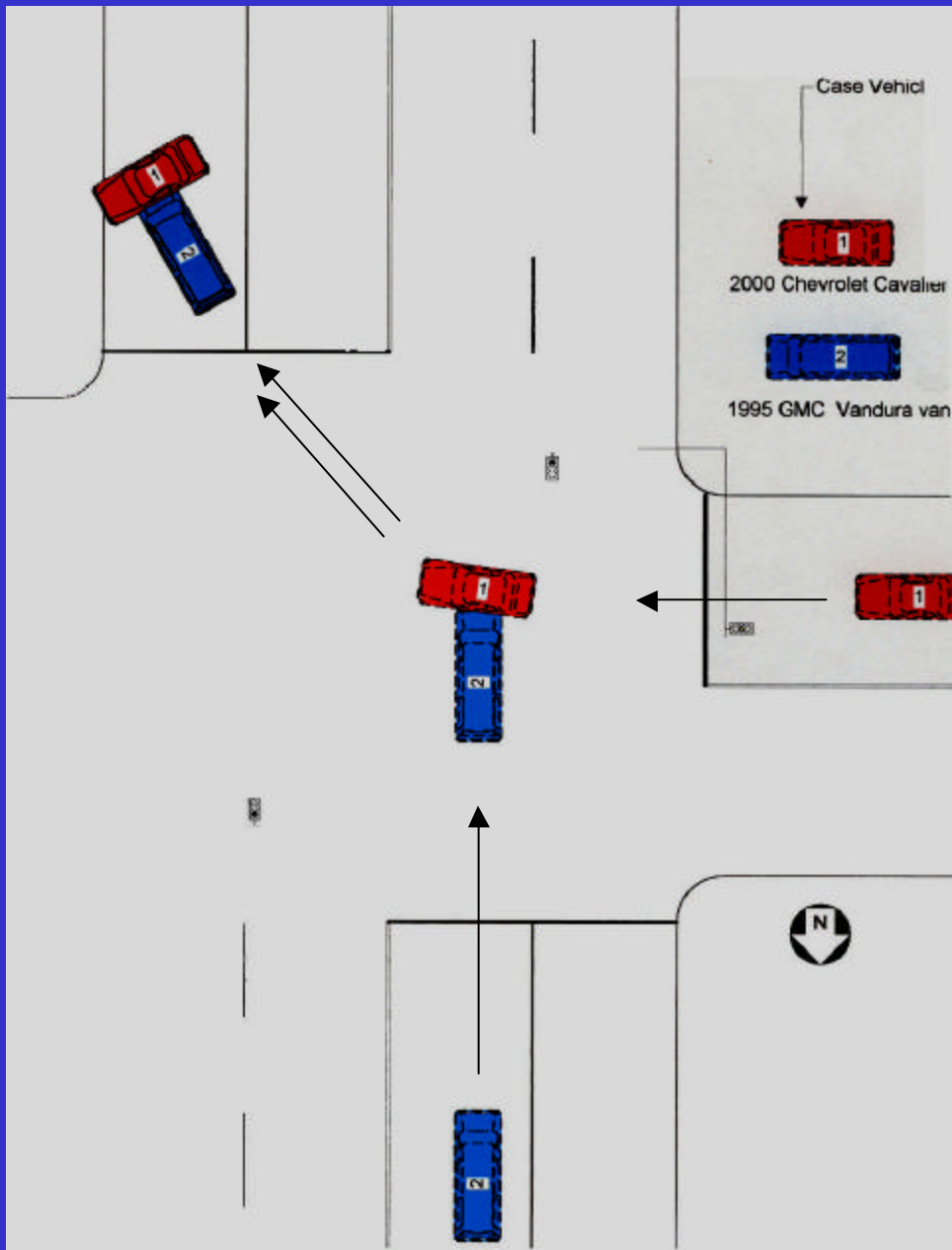
Lateral motor vehicle crash

- V1 = 2000 Chevrolet Cavalier (1189 kg)
- V2 = 1995 GMC van (1957 kg)
- Delta V1 = 56 kph (31 mph)
- PDOF = 260
- CDC = 08LPAW4
- Max crush = 56 cm at C3

Case Occupant

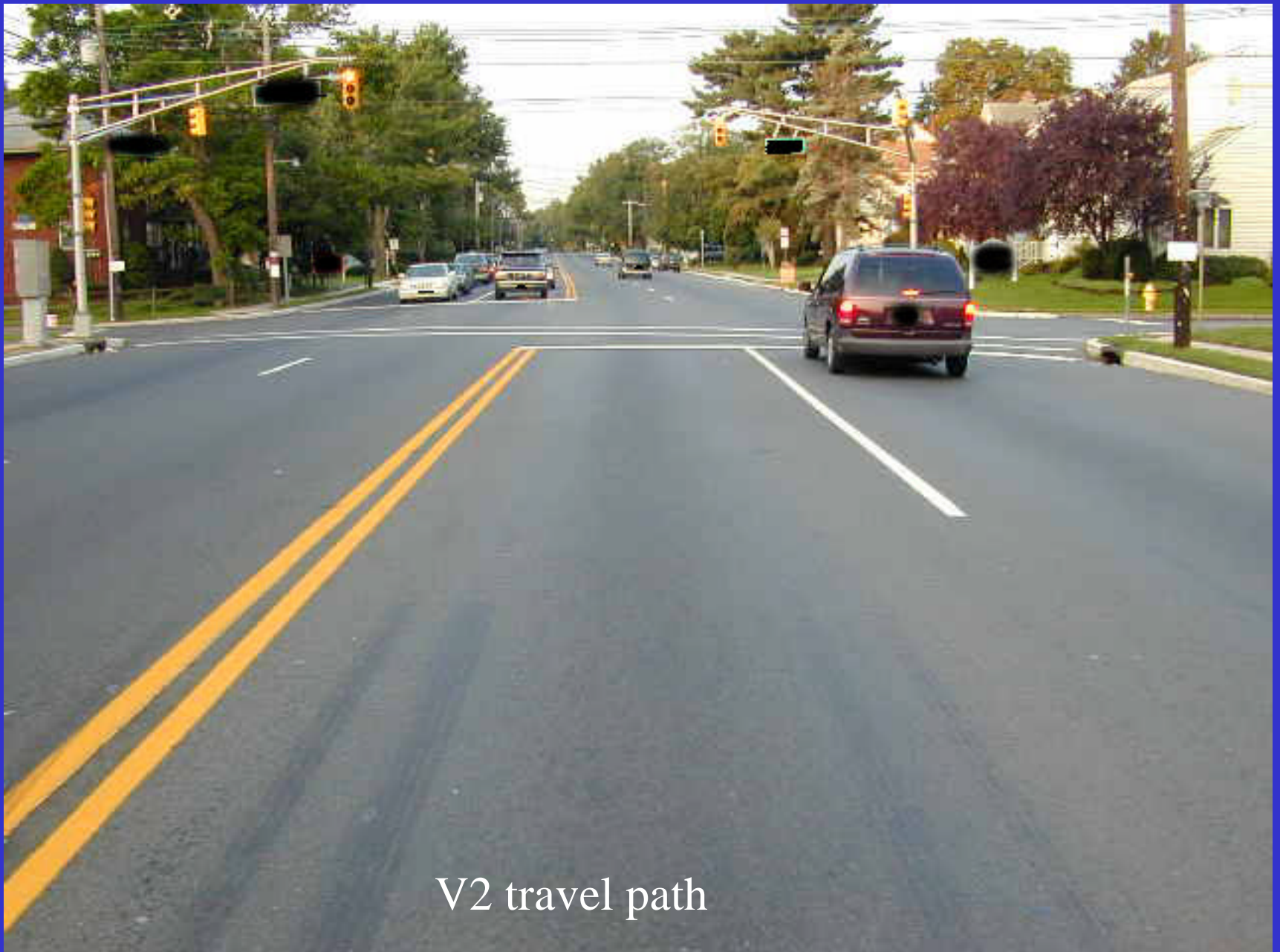
- 52 year old female
- lap and shoulder seatbelt restrained driver per EMS (seatbelt mark over pelvic area)
- 5'5", 175 lbs
- airbag did NOT deploy
- field GCS = 8
- responsive to pain only
- prolonged extrication
- intubated in field, bagged, on O₂
- shock in field, pH 7.23, BE -8.3

Scene diagram





Case vehicle (V1) travel path



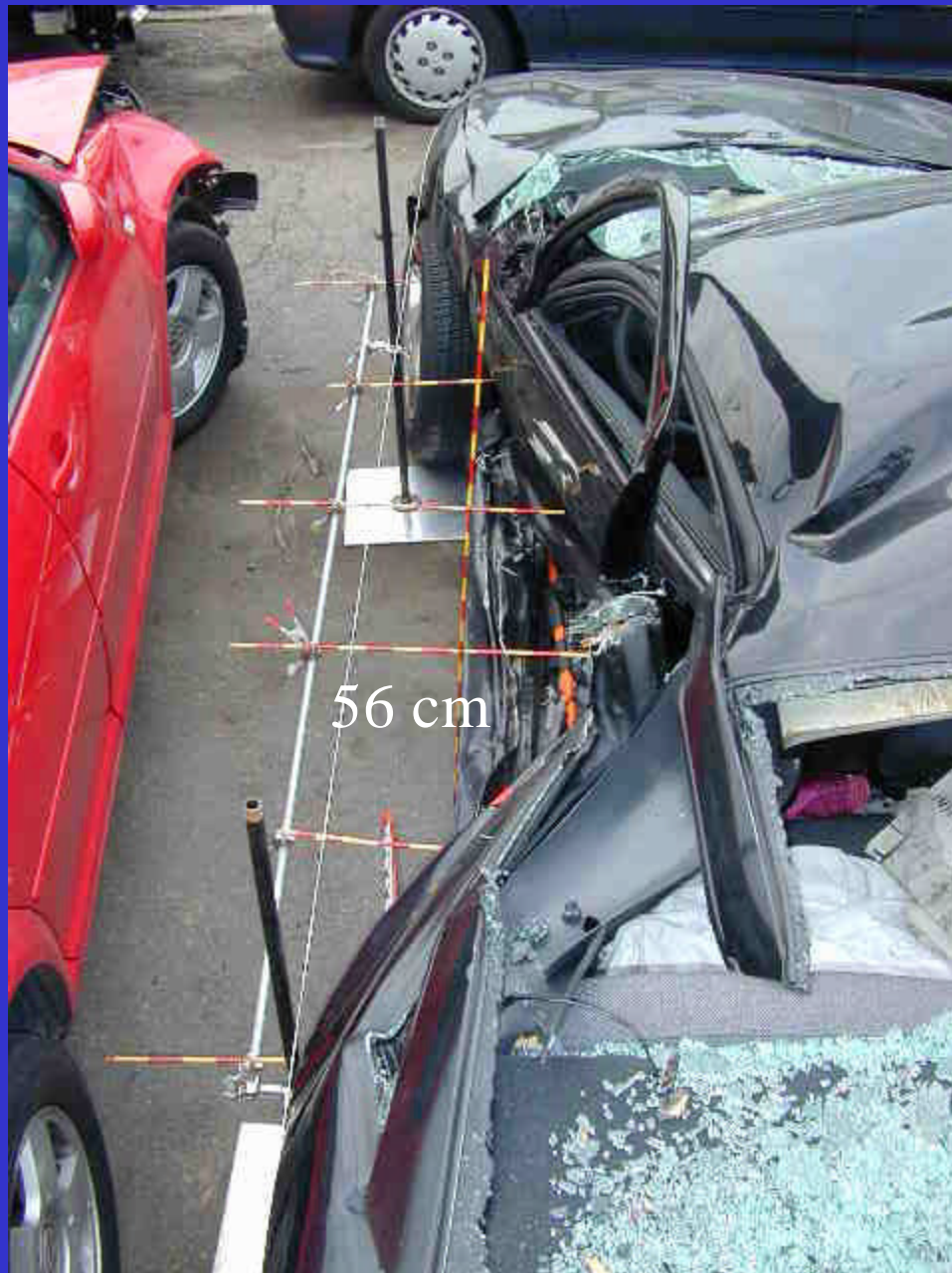
V2 travel path





impact site, lateral crash, V2 into V1

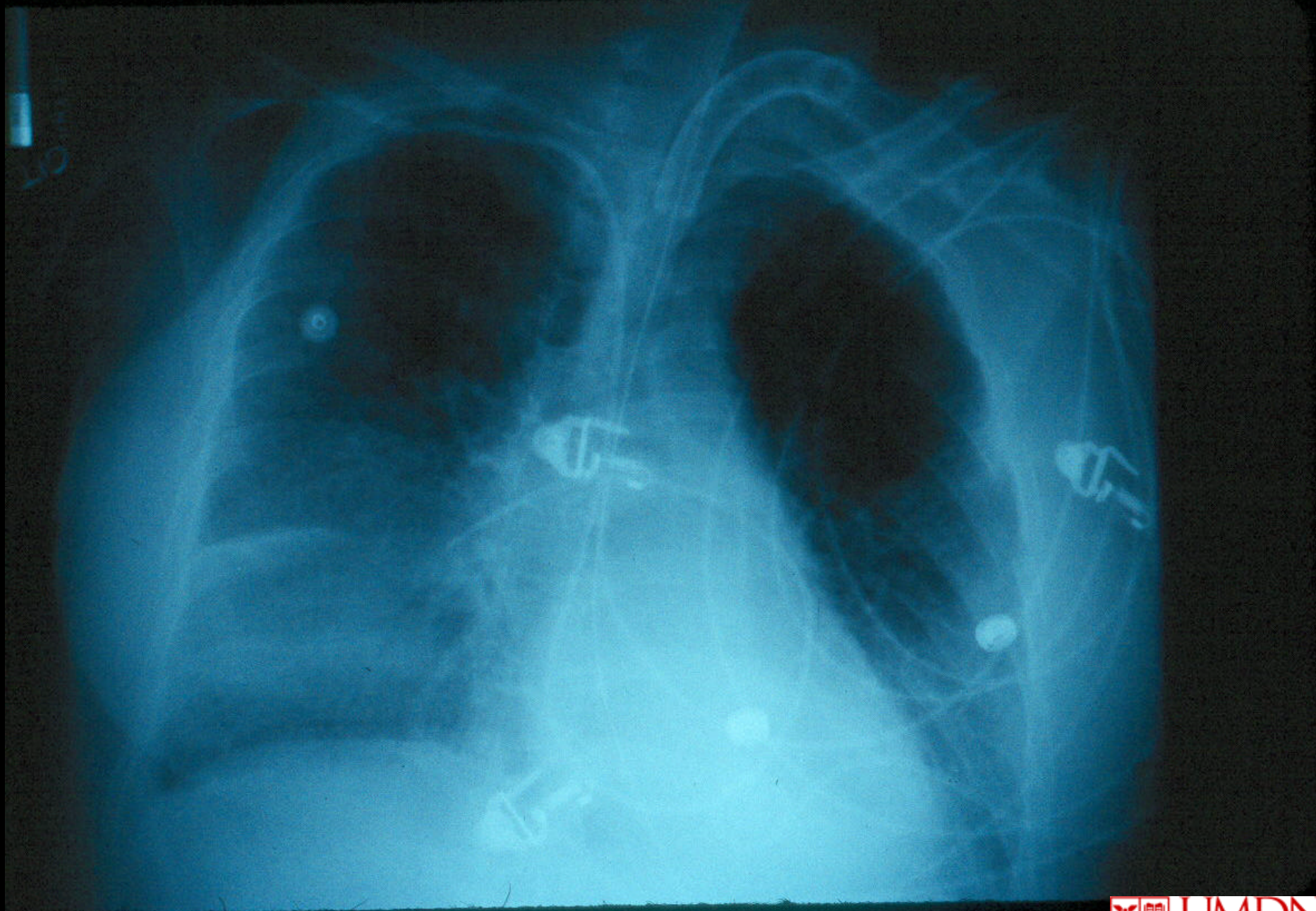


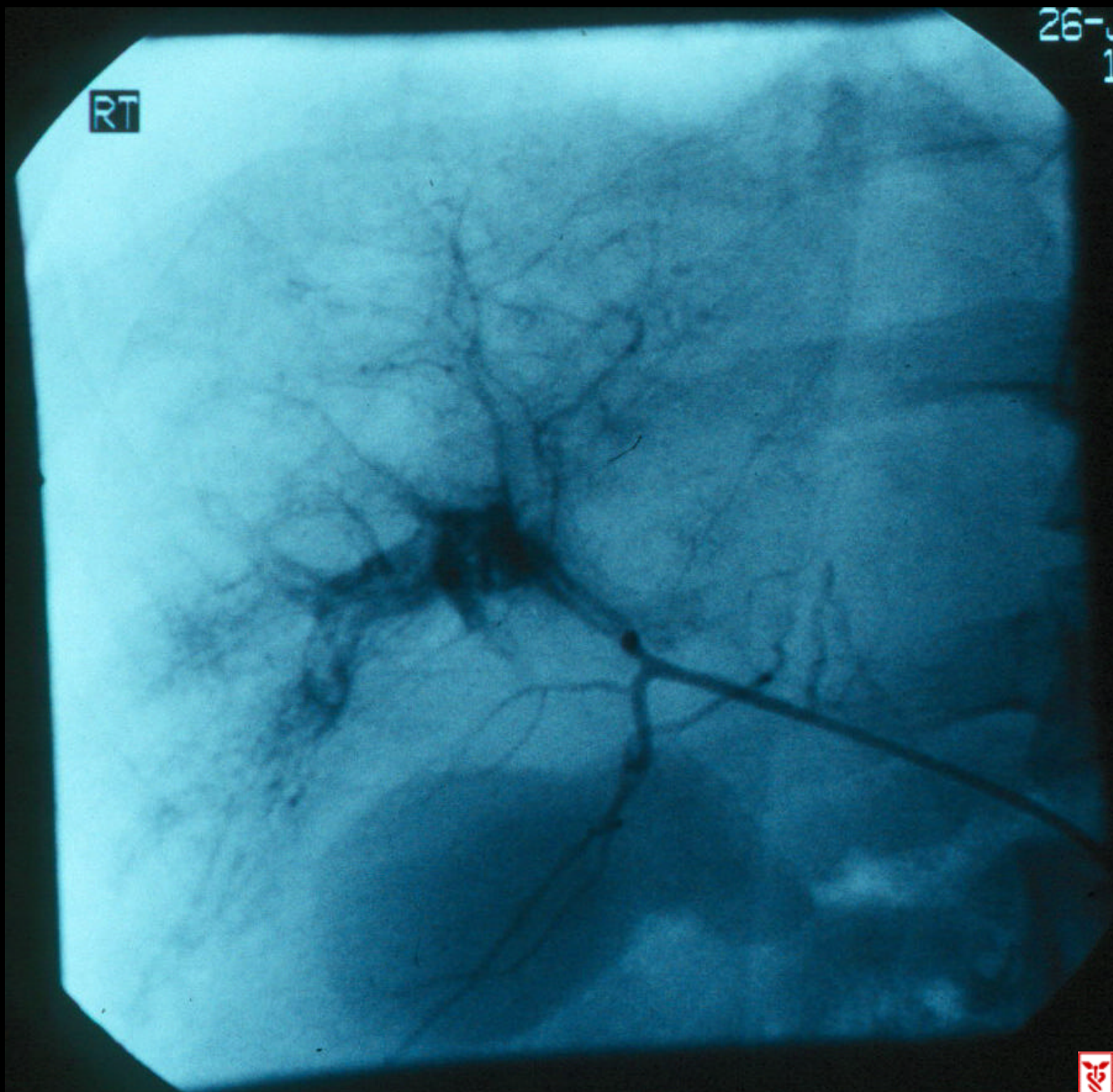












A 180

R
1
6
6

L
1
8
0

.00



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SIND

512

R

1
6
6

L

1
8
0

kV 120

mA 250

Large $\frac{5}{8}$

5.0 mm/1.6:1

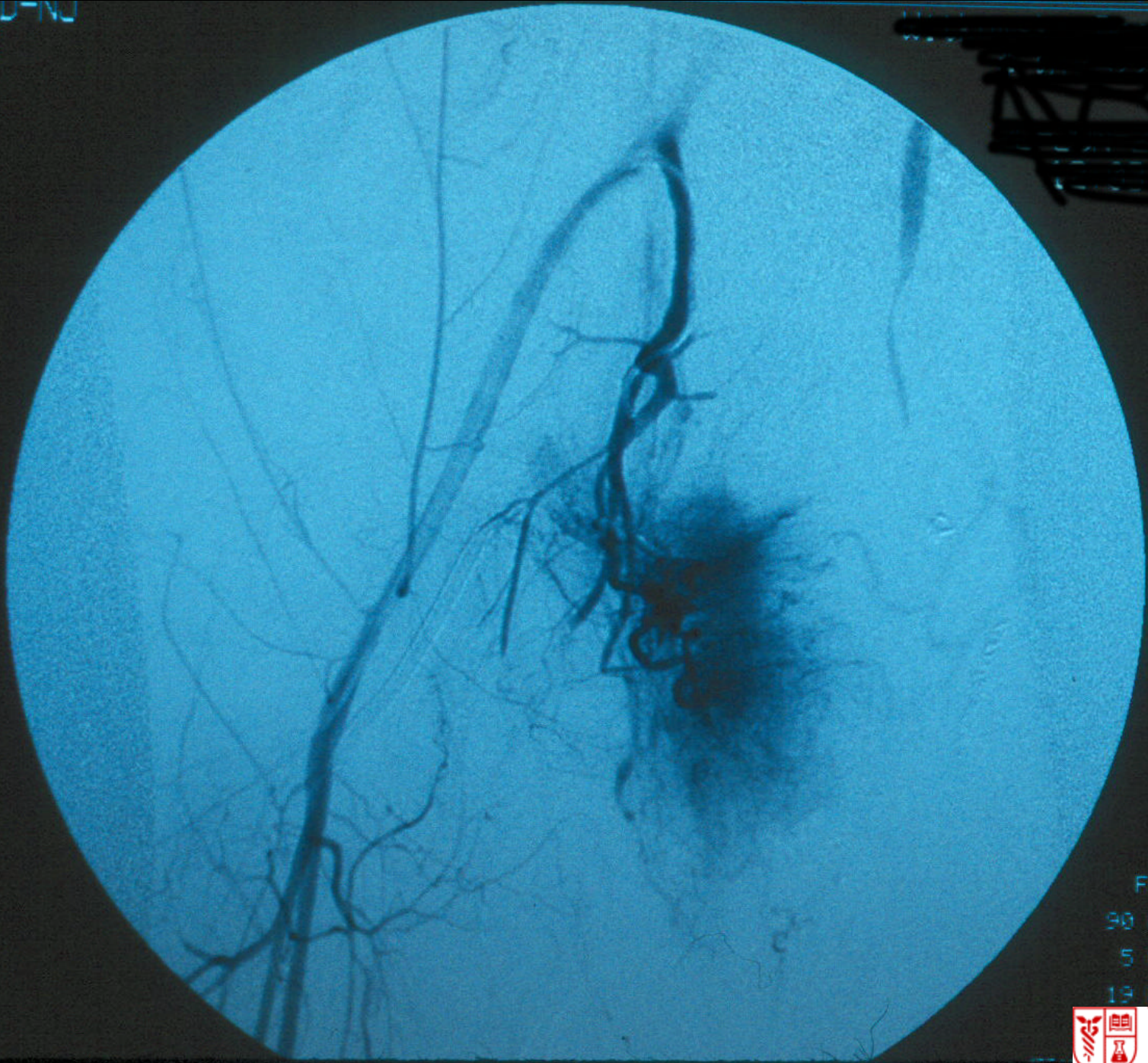
Tilt : 0.0



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SC

Handwritten notes and scribbles in the top right corner.



FRH1
90 L
5 CAL
19 LAC



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HiSpeed CT/i SYS#CT02

A 9

Ex: 43160

Se: 2

SN I302.8

Im: 81

DFOV 16.6cm

STND

R

8

3

1

3

3

kV 140

mA 250

Large %



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02

AS

R

1
1
8

L

1
1
8

kV 140
mA 170

Head
5.0 mm



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R
1
1
8

L
1
1
8

kV 140
mA 170

Head
5.0 mm
Tilt : 20.5

R
1
1
8

L
1
1
8

kV 140
mA 170

Head
5.0 mm
Tilt : 20.5

2.0 - 10:00:24 199

Lateral motor vehicle crash vs Van – Case Occupant (V1) Injury List

INJURY	SOURCE
Bilateral parietal SAH	door panel
Left frontal SDH	door panel
Bilateral subgaleal hematoma	door panel
Left hemothorax/pneumothorax	door panel
Left rib fractures (3-5, 11-12)	door panel
Small bowel perforation (terminal ileum)	steering wheel
Extraperitoneal bladder rupture	steering wheel
Left L2-5 transverse process fractures	door panel
Bilateral sacral ala fractures	door panel
Bilateral anterior acetabulum column fractures	door panel
Bilateral superior/inferior pubic rami fractures	door panel
Right superior gluteal artery lac. (shock)	center console
Right hepatic artery branch lac. (shock)	steering wheel

Therapy

- Intubated and ventilated in field
- Left chest tube for pneumothorax
- Crytalloid and blood transfusion
- Embolization of hepatic artery branch
- Embolization of right superior gluteal artery
- Foley catheter
- Exploratory laparotomy
- Tracheostomy for long-term ventilation
- Greenfield filter insertion
- Intra-abdominal sepsis with multiple abdominal washouts
- 40 days ICU, 71 days in hospital
- Discharged home

PSYCHOSOCIAL: PRIOR TO ACCIDENT

- general health “good” except for congenital spinal problem
- described self as a “nervous” person
- 5’5”, 200 lbs
- possible alcohol abuse
- smoker
- no health insurance
- had been employed primarily in factory work and other minimum wage positions but was currently on unemployment
- currently married, second marriage for both
- estranged from her mother and her adult son from a previous marriage
- had experienced a “bad year” in the year prior to accident: death of father, loss of job

PSYCHOSOCIAL: 3 MONTHS AFTER ACCIDENT

- had lost 100 lbs
- claims to have stopped drinking and smoking
- still no health insurance
- unable to work
- no disability claim initiated
- cannot leave the house, climb a flight of steps or bend down to tie her shoes or pick things up (“blacks out”)
- complains of considerable pain in abdominal region, tires easily
- unable to afford rehab or cab fare to medical follow-up appointments
- was sent home barely able to walk, but with no cane or walker to assist her
- car totaled in accident, cannot afford to replace

PSYCHOSOCIAL: 6 MONTHS AFTER ACCIDENT

- has regained 10-15 lbs
- still not drinking or smoking
- still no health insurance
- still unable to work due to physical limitations (pain on ambulation, limited motion)
- disability claim initiated
- has only walked a few steps outside the house
- can now climb one flight of stairs
- denies depression but overall functioning is at a minimal level
- has not left the house in 6 months (since hospital discharge)
- spends time at home watching TV, playing cards with (unemployed) husband
- now concerned about losing their apartment (landlord is selling the building)

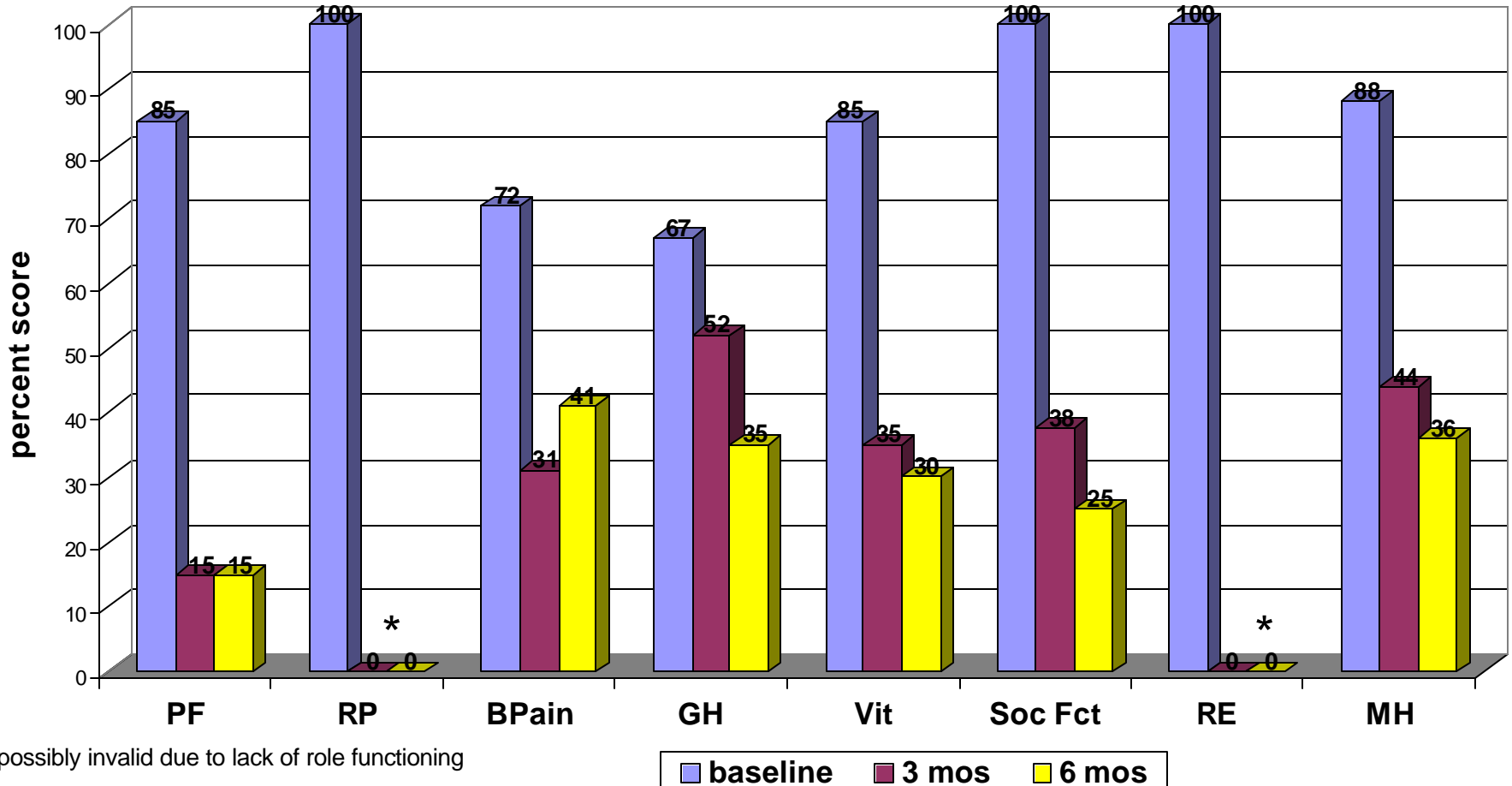
PSYCHOSOCIAL: 6 MONTHS AFTER ACCIDENT (cont'd)

- states that she has a “dent” on left side of head where major brain injury was
- denies major memory problems, but cannot remember the names of all the doctors who treated her
- does play Scrabble for recreation and has retained good spelling ability
- admits that she is occasionally confused about what day of the week it is (this could be a function of lack of schedule or routine)
- admits to feeling dizzy with positional change
- claims her stomach is bloated due to surgery (?adhesions)
- needs assistance with showering because she cannot reach all her body parts
- is unwilling to apply for public assistance

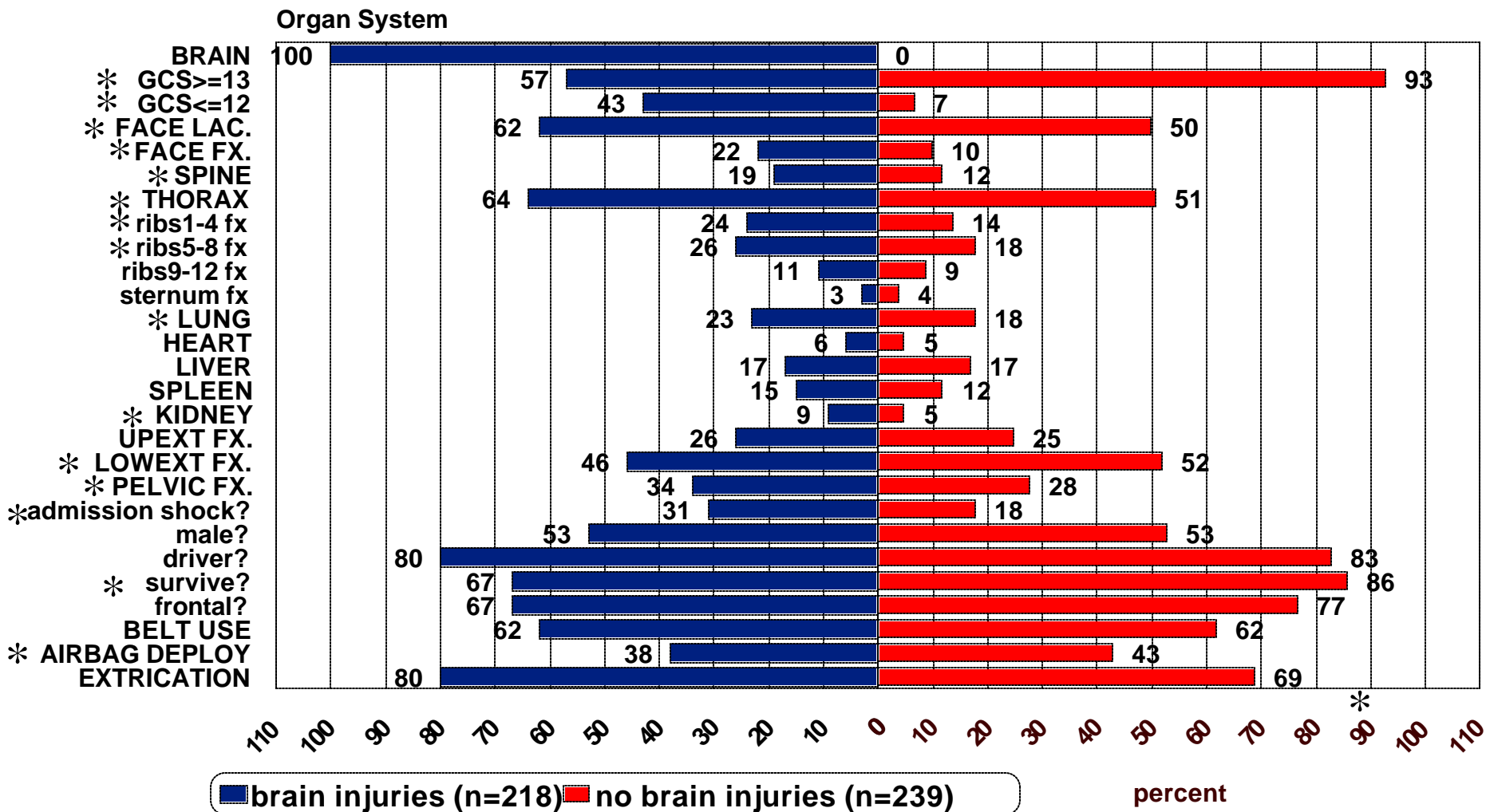
SF-36 Health Survey Brief Overview

- PF = physical functioning
- RP = role-physical
- BPain = bodily pain
- GH = general health
- Vit = vitality
- Soc Fct = social functioning
- RE = role-emotional
- MH = mental health

Case Occupant's SF-36 Health Survey Over Time

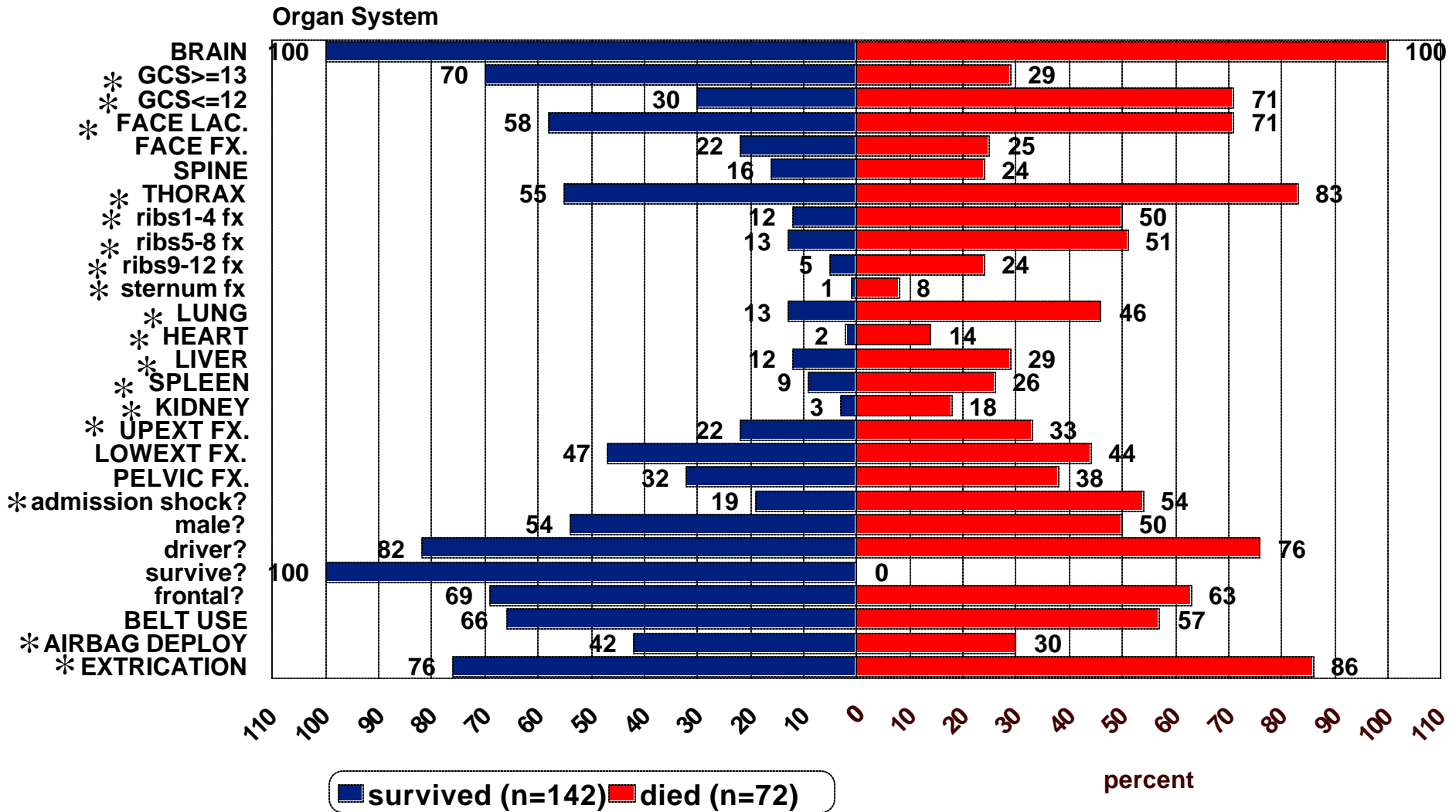


BRAIN-INJURED PATIENTS VS NON-BRAIN-INJURED PATIENTS: ALL CASES



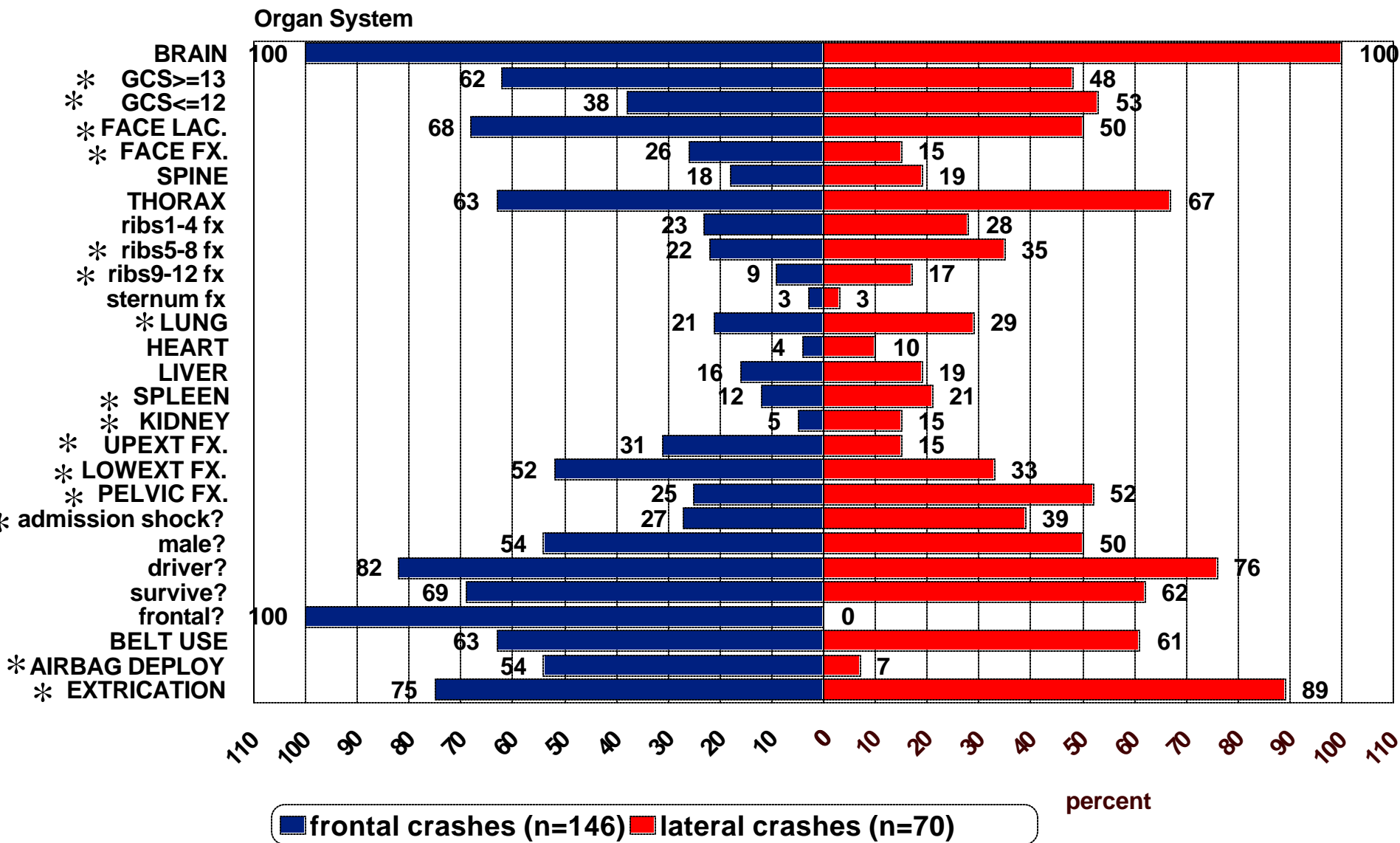
* = significant at $p < 0.05$ or better

SURVIVALS vs NON-SURVIVALS: BRAIN-INJURED PATIENTS



* = significant at $p < 0.05$ or better

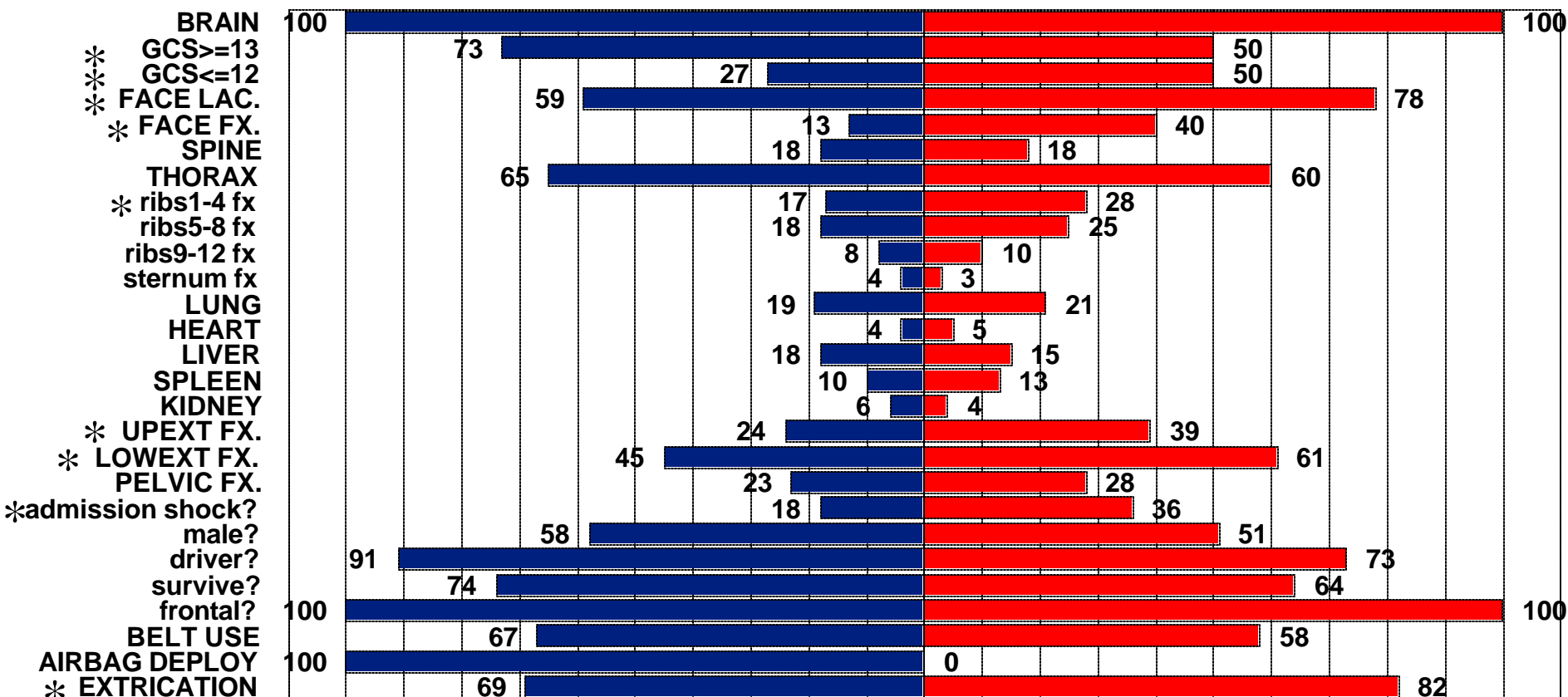
BRAIN-INJURED PATIENTS IN FRONTAL VS LATERAL CRASHES



* = significant at $p < 0.05$ or better

BRAIN-INJURED PATIENTS AND ASSOCIATED INJURIES: AIRBAG VS NO AIRBAG, FRONTAL ONLY

Organ System



110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110

percent

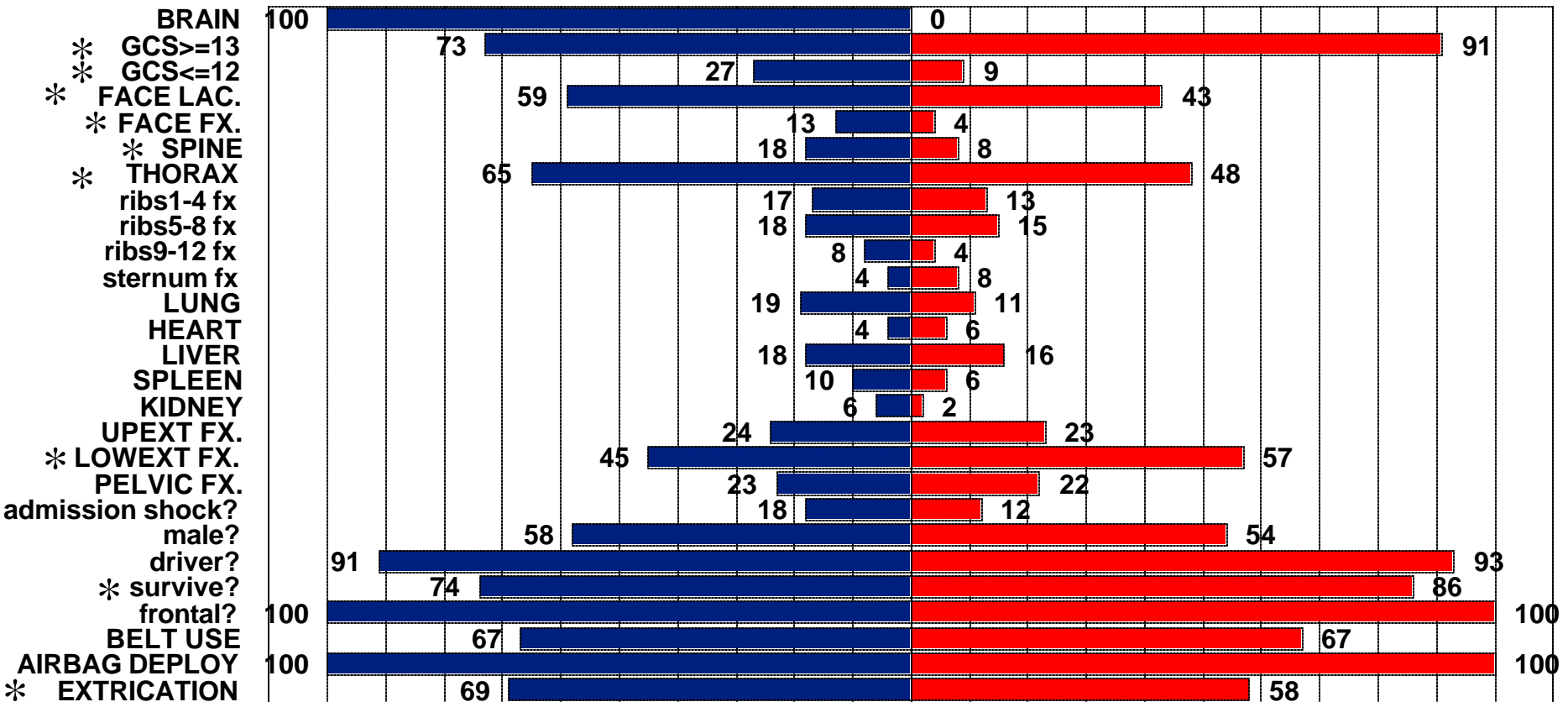
■ brain injured + airbag deployment (n=78)

■ brain injured NO airbag deployment (n=67)

* = significant at $p < 0.05$ or better

AIRBAG PROTECTED PATIENTS WITH AND WITHOUT BRAIN INJURIES AND ASSOCIATED INJURIES, FRONTAL ONLY

Organ System

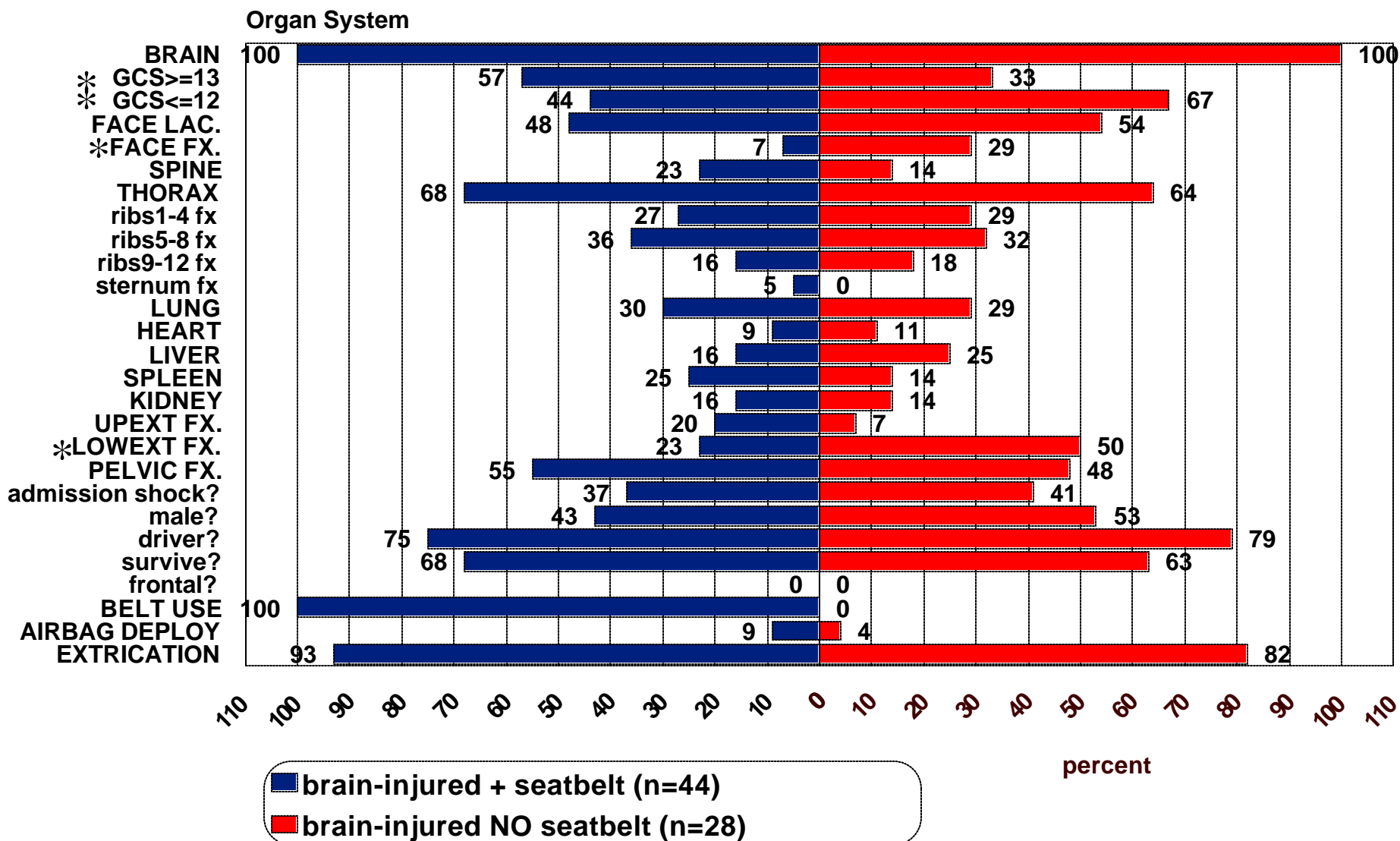


■ brain injured + airbag deployment (n=78)
 ■ NO brain injury + airbag deployment (n=95)

percent

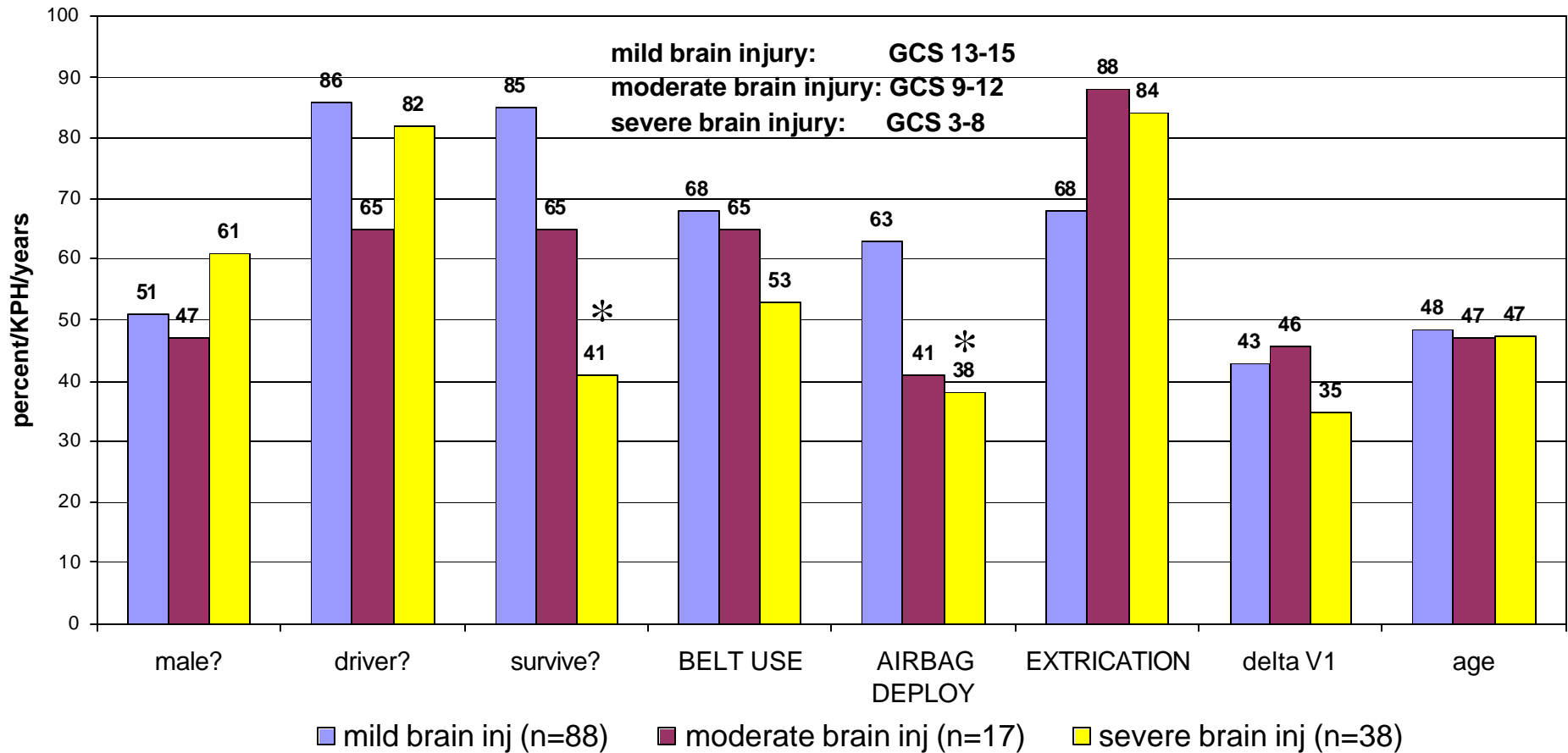
* = significant at $p < 0.05$ or better

BRAIN INJURED PATIENTS WITH AND WITHOUT SEATBELTS AND ASSOCIATED INJURIES, LATERAL ONLY



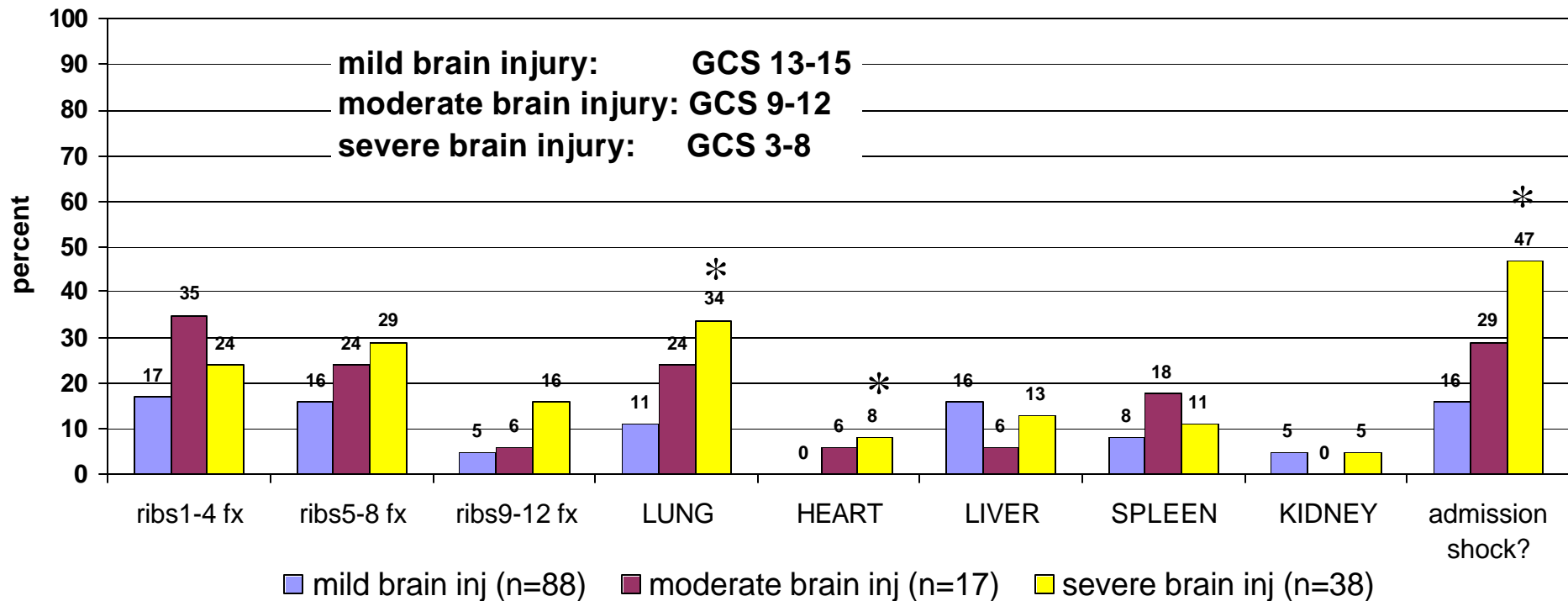
* = significant at $p < 0.05$ or better

Demographic Factors Associated with Brain Injuries of Varying Severity



* = $p < 0.05$ vs mild brain injury

Thoracic Injuries Associated with Brain Injuries of Varying Severity



* = $p < 0.05$ vs mild brain injury

Conclusions

- In multiply-injured MVC patients, the presence of a brain injury is associated with decreased survival. This tends to be associated with a more severe pattern of organ and skeletal injuries. This is most marked in brain-injured patients sustaining a lateral crash.
- In frontal crashes, airbag deployment results in a significant decrease in more severe brain injuries as well as a reduction in facial fractures and lacerations, thorax injuries and extremity injuries, which may contribute to the significantly reduced incidence of shock on admission. However, while there appeared to be a reduction in mortality, this trend was not statistically significant.

Conclusions, cont.

- In lateral crashes, seatbelt usage significantly reduces the incidence of severe brain injury (GCS \leq 12), facial fractures and lower extremity injuries. However, there was no significant effect in reducing mortality.
- In brain-injured patients with associated traumatic injuries of the skeletal system, especially the pelvis, or major injuries to the abdominal viscera, which require operative intervention, the disability is often secondary to the non-brain injuries and may persist long after the brain-related disability has resolved.

Conclusions, cont.

- When brain injuries are divided into mild (GCS 13-15), moderate (GCS 9-12) and severe (GCS 3-8), for the same delta V and age range, more severe brain injuries had lower belt use and a significant reduction in airbag deployment, associated with a significant reduction in survival. This appeared to be related to an associated increase in thorax, lung and cardiac injuries with a significant progressive increase in admission shock.
- In the presence of a brain injury, seatbelt and airbag protection against associated visceral and skeletal injuries and consequent shock appears to play a major role in improving the patient's ultimate outcome.